

## AN OVERVIEW OF NASA LUCY MISSION'S ENCOUNTER WITH THE MAIN BELT ASTEROID DINKINESH. H. F. Levison<sup>1</sup>, S. Marchi<sup>1</sup>, K. S. Noll<sup>2</sup>, J. R. Spencer<sup>1</sup>, T. Statler<sup>3</sup>, and the Lucy Science team,

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**Introduction:** On November 1, 2023, *Lucy* passed within 430 km of the smallest Main Belt asteroid yet to be encountered by a spacecraft, (152830) Dinkinesh. This target was a late addition to the Lucy mission [1] and was intended primarily as an in-flight test of Lucy's autonomous range-finding and tracking system [2]. Dinkinesh orbits the Sun near the inner edge of the Main Asteroid Belt with a heliocentric semi-major axis of 2.19 AU. Its ground-based reflectance spectrum shows a silicate band at 0.95  $\mu\text{m}$  best fit as an Sq-type [3,4].

*Lucy* approached Dinkinesh at a solar phase angle of 120°; at close approach the phase dropped rapidly, going through near-zero and then increased to an out-bound phase of 60°. The relative velocity of *Lucy* and Dinkinesh was 4.5 km/s.

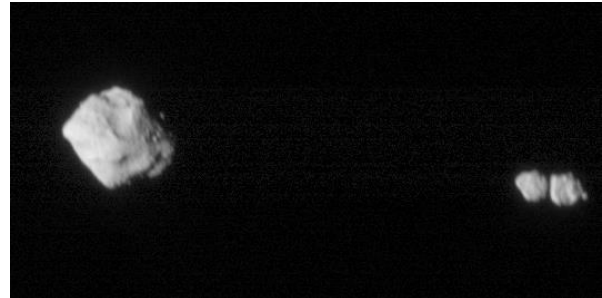
**Observations:** The analysis presented here is based on panchromatic (350 — 850 nm) images taken with *Lucy*'s Long Range Reconnaissance Imager, hereafter L'LORRI, which is a 20.8 cm,  $f/13$  telescope feeding a  $1024 \times 1024$  pixel CCD focal plane [5]. L'LORRI has a field of view of 0.29° and a pixel size of 5  $\mu\text{rad}$ .

Fig. 1 and 2 show two images of the Dinkinesh system taken within a few minutes of close approach.



**Figure 1:** A L'LORRI image of the Dinkinesh system taken near the moment of close approach. The spacecraft was roughly 430 km from the primary. The geometry of the encounter was such that the satellite, Selam, passed behind Dinkinesh. Ecliptic north is approximately up.

**Results:** *Lucy* revealed Dinkinesh, which has an effective diameter of only ~720 m, to be an unexpectedly complex system. Of particular note is the discovery of the first confirmed contact binary asteroid satellite, now named (152830) Dinkinesh I Selam. Selam consists of two near-equal sized lobes of ~200 m each. It orbits Dinkinesh at a distance of roughly 3km.



**Figure 2:** A L'LORRI image of the Dinkinesh system taken about 6 minutes after close approach. The spacecraft was ~1600 km from the primary. Ecliptic north is approximately up.

Dinkinesh has two major geological features: a longitudinal trough and an equatorial ridge. The ridge overlays the trough implying that it is the younger of the two structures. However, there is as yet no information to better constrain their relative ages, and thus they could potentially have formed in the same event. Indeed, Dinkinesh's ridge and trough are likely the result of mass failure and the reaccretion of material, and may both be linked to the formation of Selam.

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**References:** [1] Levison H. et al. (2021), *PSJ* 2(5), 171. [2] Olkin C. et al. (2021) *PSJ* 2(5), 172. [3] Bolin B. (2023) *Icarus* 400, 115562. [4] de León J. et al. (2023) *A&A*, 672, A174. [5] Weaver H. et al. (2023) *SSRv*, 219, 82.